Volume: 3 Issues: 15 [June, 2018] pp.71-78
International Journal of Education, Psychology and Counseling
eISSN: 0128-164X
Journal website: www.ijepc.com

CHILDREN AND TEACHER'S INTERACTION FOR ENGLISH PRE-LITERACY USING MOBILE AUGMENTED REALITY

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Accepted date: 03 December 2017 **Published date**: 11 July 2018

To cite this document: Majid, N. A. A., Arshad, H., & Yunus, F. (2018). Children and Teacher's Interaction for English Pre-Literacy Using Mobile Augmented Reality. *International Journal of Education, Psychology and Counseling*, *3*(15), 71-78.

Abstract: *Problems in teaching pre-literacy such as non-native teachers, teachers vary in language acquisition and human factors such as emotional involvement are expected to be reduced by using augmented reality (AR) technology in mobile platforms. However, proper interaction should be provided so that the developed AR based app may bring effective learning. Therefore, the objective of the study is to design and develop mobile applications based on AR for letter recognition with proper interaction called AR letter kit. Two versions of AR Letter Kit were developed and designed where the second version with more multimedia components in order to provide more interaction. The research design is case study in Early Childhood Education for children ages 4 to 6. The results show that the teacher showed positive attitude to the developed apps but preferred the second design with more added multimedia components. The children also show positive attitude towards the app and pointing, responding and inspecting during the AR Letter Kit activity. The children also preferred the second design and give more engagement during the activity. This study supports proper interaction can be provided by adding more multimedia components towards the learning object to get more engagement. This study also suggests the addition of multi modal in enhancing interaction and promoting cognitive skills.*

Keywords: *Mobile Augmented Reality; Pre-Literacy; Letter Recognition; Multi-Modal*

Introduction

A new approach for promoting pre-literacy skills for children is needed because most children now are currently in digital native. Promoting pre-literacy at early stage using appropriate technology can allow teachers to optimize their ability to teach children at full concentration and fun. This is because the technology not only can support the learning by acquiring operational skills, but also by extending knowledge (Plowman, Stevenson, Stephen, & McPake,

2012). However, developing a teaching tool using an appropriate technology for early literacy has proven difficult since learning styles for children over age three are diverse and teaching based on traditional teacher-directed and verbal approach may not the optimum way for children in learning (Wardle, 2008).

Because the use of computers can allow children to learn at their own individual pace compared to traditional teaching, this computer technology is not only very effective for early literacy but also for linguistics and emotional skills (Vernadakis, Avgerinos, Tsitskari, & Zachopoulou, 2005). Mobile applications are an interesting teaching and learning tools because it is not only providing self-paced learning but also considers the movement of the children. An innovative in teaching using mobile technology is enhancing children perception towards learning object by adding digital materials. This approach is known as AR. This approach was utilized in English learning system such as Augmented Reality English Learning System (Hsieh & Lee, 2008), Augmented Reality English Vocabulary Learning System (Hsieh & Koong LIN, 2010) and Handheld English Language Learning Organization (Liu, Tan, & Chu, 2009). Most of the researchers developed their approach using flashcards. Since flash cards for letter recognition can be the learning object in using AR technology, therefore this study been designed to investigate the potential of using mobile AR technology for pre-literacy by combining the flash card with digital materials.

The digital materials which consisted of multimedia components must be properly designed in order to provide a proper interaction. Usually the interaction has been limited to either passive viewing or simple browsing of virtual information (Billinghurst & Lee, 2012). The objective of this study is to compare two designs of AR based app, one with the simple browsing of virtual information, and the other one with added interaction for letter recognition. Letter recognition or letter reading is the first step in reading fluency, followed by word reading and finally the reading of phrases, sentences and passages (McLachlan, Nicholson, Fielding-Barnsley, Mercer, & Ohi, 2012). Since letter recognition will be the main scope for this study, the developed research question is how do children and teachers behave and interact when using mobile app based on AR for letter recognition with different multimedia components?

Method

In this study, case study was used as the research design. The sample consisted of a female teacher and six children aged 4-6, 4 boys and 2 girls in an early childhood class in Malaysia. In this case study, two different designs for letter recognition application were used and the applications were developed. The name of the app is AR letter kit.

The Design for AR Letter Kit

AR letter kit was developed with three levels of learning steps in order to promote letter recognition in terms of the name of letters, the sound of letters, the examples of objects associated with letters and the recognition of letters with objects. The core strategy is to use AR for letter recognition to achieve standardization, repetition, sensory based activities and social environment. There are three levels in this design as shown in Figure 1.

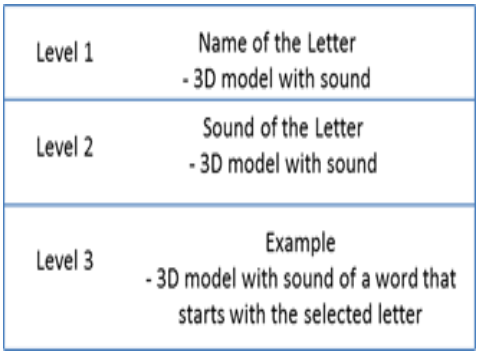

Figure 1: The design of the AR based application for letter recognition

Firstly, the goal of level 1 is to visually highlight the selected letter with its name. It is to help children to associate the letter of the card with its name by referring the sound that comes along with a 3D model of the letter. The children are encouraged to play the sound more than one time. Secondly, the goal of level 2 is to facilitate the children to recognize the sound of the letter in the flash card. A 3D model of the letter will be overlaid on the screen phone with the sound of the letter. The children are encouraged to play with the sound for more than one time. Finally, the goal of level 3 is to further children's abilities in recognizing letters. To achieve this goal, two 3D models will be provided for each letter using AR. For example, for letter A, the selected 3D models that start with letter A are Apple and Alligator. The children are encouraged to play the sound of the words than one time. The children in one class can listen to the same standardized sound although with different teachers. The interaction in Figure 1 is followed the usual interaction to either passive viewing or simple browsing of virtual information. In order to add interaction to the app, more multimedia components were added. The design in Figure 1 is added with more multimedia components which are scaling and rotating of 3D models. This second design is shown in Figure 2.

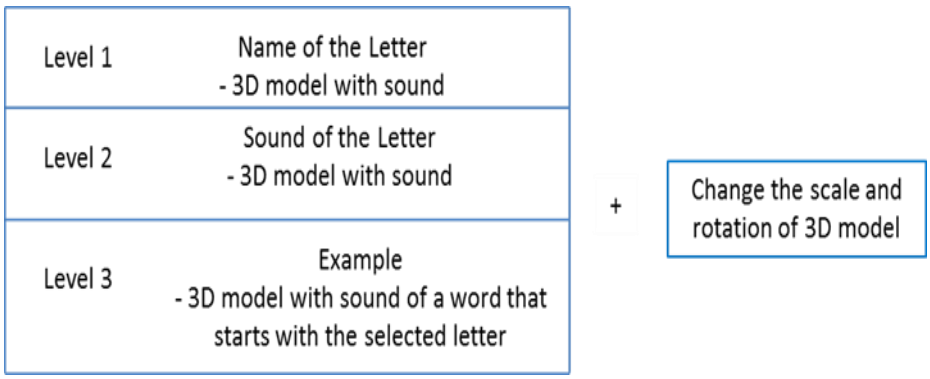

Figure 2: The design of AR based application for letter recognition with extended multimedia components

System Components of AR Letter Kit

The development of the application for letter recognition based on AR involved a number of components as shown in Figure 3. The app for the AR letter kit was developed in a Unity 3D platform. The markers, letters A to Z, were set as targets for the application using Vuforia Developer Portal. The targets were imported to the 3D Unity where Vuforia SDK was used for capturing, tracking and rendering in an AR environment. Android SDK was used for Android platform. Blender was also used to develop 3D models for the application. When the application has been installed in an android mobile phone, users can direct the open application to scan a

printed marker. The capturing component of the application will capture the image of the marker. Next, the tracking component of the application will decode the captured image using the Vuforia engine and compared the image with the targets. If the captured image hit the target, the rendering component of the application will draw an AR output overlay on the mobile screen.

Each marker will have three different AR outputs depending on the selected buttons by a user. After testing the marker, we identified that markers with laminate have some difficulties for tracking because of light reflection. To solve this problem, the script for camera focus has been added to the Unity. Because of the quality of the markers that was quite low, the name of the app and additional symbols like stars were added to the marker. The marker will be printed and virtual objects related to the marker will be identified accordingly, for example, B for butterfly and ball.

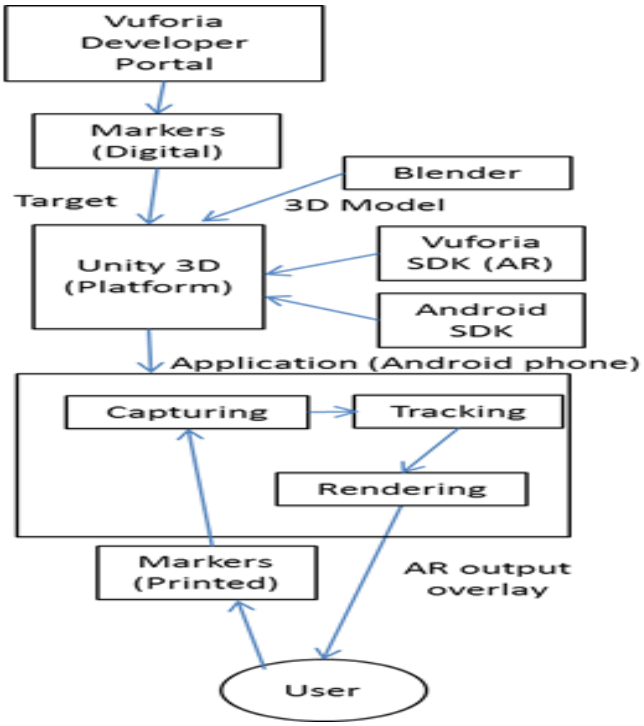

Figure 3: System components in AR letter kit

The first design in Figure 1 was developed and the prototype is shown in Figure 4. Eight buttons were added on the main screen of the mobile app. The first button was for the name of the letter. The second button was for the sound of the letter. The following third to eight buttons were for example of 3D models associated with the letter. In order to add more multimedia components, the interface has been modified and the result for the second design is shown in Figure 5. Figure 5(a) shows that the virtual object such as a cat is scaling up with audio which is the name of the letter when button Name is clicked. In Figure 5(b), the cat is scaling down with audio which is the sound of the letter when button Sound is clicked. Figure 5(c) shows that the cat is rotating with audio which is the sound of word cat when button Object is clicked.

Figure 4: The user interface for the first design

Figure 5: The user interface for the second design where three interactions were added to the app which are: (a) scaling up, (b) scaling down and (c) rotation.

Research Process

The teacher was firstly explained by the researcher on how to use the AR letter kit. The teacher was then used it to teach the children as shown in Figure 6 for example. Then each child used the app freely.

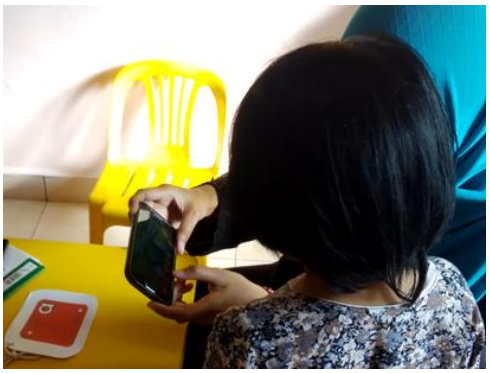

Figure 6: Teacher uses the app to teach a child

Results and Discussion

It was observed that the children liked to inspect the 3D model and try to touch the model. They also liked to point to the marker. When the teacher asked some questions, the children gave appropriate responds and most of the answers were correct. The children liked both designs but the second design (design B) gets more engagement since the interaction in the first design was limited to passive viewing of the virtual information. When the children have to touch some buttons to scale up, to scale down or to rotate the 3D model in the design B, it gives more control to the children in manipulating the 3D model. This control power contributes to longer attention towards the app and eventually will promote more learning since every action of touching the buttons comes with related audio. The main findings are given in Table 1.

Table 1: Interaction of teacher and children in using AR Letter Kit

Interaction Behaviour	Design A	Design B
Viewing virtual information	Yes but with less time than design B	Yes but with longer time than design A
Inspecting markers	Yes	Yes
Pointing to the 3D models	Yes	Yes
Scaling the 3D models	Not applicable	Yes

The results show that the children and teacher involved with interaction-oriented behaviour towards the AR letter kit. They were inspecting the markers, pointing to the 3D model and responding to the questions given by the teacher. Their interaction shows that they have positive attitude towards the app. Since AR applications perceived as magical tool by children (Bujak et al., 2013; Yilmaz & M., 2016), the AR letter kit has made the learning of letter recognition in more interactive way. However, it was also observed that children aged four had difficulties in holding the phone especially when interacting with the app.

Adding Multimodal Interaction and Multimedia Components

The difficulty in holding the mobile phone when interacting with the AR based app can be assisted using additional inputs such as speech recognition. Combining a speech-input with other inputs such as touch or gesture-input can form multi-modal inputs in an augmented reality environment (Billinghurst & Lee, 2012). This multimodal concept has been investigated in improving the problem in interaction (Hürst & Van Wezel, 2011). Since speech recognition supported games can be used to improve literacy (Kumar, Reddy, Tewari, Agrawal, & Kam, 2012) therefore, adding a speech-input in an AR based environment can further help the children in using the AR based literacy app.

In order to implement the speech-input, the children can first watch a video (Figure 7). This video is added as an additional multimedia component to emphasize the usage of a word in a sentence. An example of sentences for word apple in a video can be “An apple is on a card”. Then, there is a new scene that receives speech-inputs from a child. In this scene, the child sees first the 3D model appears on the mobile phone screen. The child can touch the 3D model (Figure 8) and based on the action, a sound will be played. If the 3D model is an apple on a card, so the sound will be “An apple is on a card”. The child can repeat the sound and this give the speech input to the app. The app will give feedback to the child whether the sentence was pronounced correctly or not.

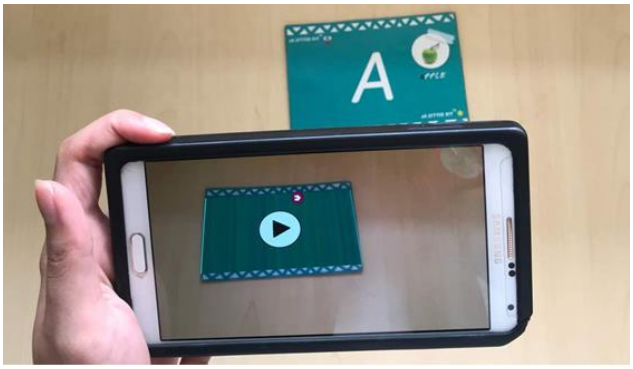

Figure 7: A video for each letter

Figure 8: Touch and drag a 3D model using fingers

The flashcard in Figure 7 and Figure 8 are the latest design for the AR Letter Kit app. Our current work now is focusing on adding a new multimedia component and a new input for proper interaction. Further study will focus on evaluating the satisfaction and the effectiveness of the app based on the new design.

Conclusion

In this work, the interaction of the teacher and children on using the AR letter kit were observed. The results revealed that the teacher and children show more interaction behaviour towards the second design of the app. This is because the second design has additional functions that make them to give more active feedbacks. Future research might investigate the use of the app on a specific theme with more added interaction such as voice or gesture. For example, exploring objects in a kitchen, classroom, garden or library where the related virtual information can be manipulated using not only using the usual click on the touch screen, but also voice commands and hand gesture.

Acknowledgment

We acknowledge our GUP-2015-008 grant for funding this research.

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